Certain agricultural crops as well as ornamental plants are sensitive to salts that may originate from water softeners and other sources.

Approach and Implementation:

In order to ensure that the design of wastewater treatment and water recycling facilities will meet regulatory requirements, it is necessary that the requirements be known before the beginning of design. The RWQCBs should be involved during the planning process of projects so that issues can be resolved and projects can proceed without regulatory delays during design and construction. Time frame: July 2003-on-going.

Recommendation 4.3.6.

Each RWQCB should have a resident expert or ombudsman on water recycling to provide consistency in permitting, coordinate with the SWRCB and other RWQCBs in maintaining consistency, and to assist agencies in facilitating permitting and conflict resolution.

Approach and Implementation:

Because of a lack of familiarity with issues and regulations peculiar with water recycling, some RWQCB staff may provide guidance to agencies that is inconsistent with other staff or with appropriate interpretation of regulations. Assigning a person at each RWQCB office as a specialist or ombudsman in water recycling would provide a resource for the office as well as a liaison with the SWRCB, DHS, and other RWQCBs to improve understanding of regulations and consistency in their application. An ombudsman would also serve as a contact person for the public and agencies to help them understand the regulations and the procedures needed to receive permits to proceed with projects. This person could also act as a mediator between the public and RWQCB staff when conflict arises to help clarify issues and determine the most efficient way to resolve the conflict. Time frame: July 2003-on-going.

4.4. WATER SOFTENERS

Issue

Over the last few decades, increasing numbers of residents in California have installed water softeners in their homes to reduce problems caused by hard water. Unfortunately, the use of softeners, particularly onsite, self-regenerative water softeners, has led to increased salt in the water that is recycled from municipal wastewater. Any salt added to recycled water can push recycled water agencies into non-compliance with their water quality permits and make the recycled water unmarketable for irrigation use, currently the primary use throughout the State, and for some industrial uses. Restrictions on the use of water softeners by local agencies have been overturned in court suits. Legislative attempts have been made to strengthen local control over household water softeners to allow more restrictions, but little headway has been made against the resistance of water softener manufacturers. Three recommendations have been developed to address this issue.

Recommendation 4.4.1.

Local agencies should be empowered to regulate the discharge of residential water softeners in the same manner as other sources of discharge into sewers. Legislation should be proposed to amend the Health and Safety Code Sections 116775 through 116795 to reduce the restrictions on the local ability to impose bans on or more stringent standards for residential water softeners.

Approach and Implementation:

Existing law establishes efficiency standards for self-regenerative water softeners in terms of the amount of water hardness reduction per pound of salt addition. Local agencies are allowed to regulate water softeners but only under conditions wherein the local agency is out of compliance with its discharge permits. The most significant contributions of other pollutants to sewer systems are more easily regulated. It is recommended that the Legislature should pass more flexible regulatory provisions for water softeners. Time frame: July-December 2003.

Recommendation 4.4.2.

On-going or proposed studies on water softeners should continue to be pursued to develop alternatives for salt reduction in recycled water. Funding should be sought for such studies.

Approach and Implementation:

There are two on-going studies related to salinity in wastewater, salinity management practices, and water softeners. They are being conducted by the American Water Works Association Research Foundation and the Municipal Water District of Orange County and will be completed in 2003A committee should be established to review the literature and on-going and proposed studies on water softeners and their contribution to salinity problems with the purpose of identifying additional study needs. It is suggested that a research-related institution, such as the WateReuse Foundation initiate this committee. Time frame: July-September 2003.

Recommendation 4.4.3.

Within the current legal restrictions, local agencies should consider publicity campaigns to educate consumers regarding the impacts of self-regenerative water softeners and promote the use of off-site regeneration by service companies. They should also consider financial incentives to upgrade older inefficient appliances to the current standards.

Approach and Implementation:

Local agencies can influence consumer use of self-regenerative water softeners through education and financial incentives to replace older water softeners with more efficient ones that would reduce the salinity problem. Time frame: July 2003-on-going.

5. Economics of Water Recycling

Economic analysis of water recycling projects takes into account the true benefits and costs incurred to society. This entails the examination of the benefits and costs one would expect to be associated with a recycled water project. Financial analyses, in contrast to economic analyses, are intended to determine cash flow for a project and the feasibility to secure sources of funds to pay for project capital and operating costs. Financial analyses are commonly performed by agencies, but economic analyses typically are not unless they

Currently, El Dorado Irrigation District supplies about 1,000 homes in the El Dorado Hills Serrano residential development with recycled water for front and backyard irrigation.

are required by funding agencies as a funding criterion. Economic analyses, similar to environmental impact studies, allow a full and transparent accounting of costs and benefits to readily identify impacts not apparent in single viewpoint of most financial analyses. In addition, by analyzing all alternatives to water recycling to achieve project objectives, such as water supply, all alternatives can be compared on an equivalent basis to identify alternatives that have the least net cost to society.

Examples on the benefits side of a recycled water project are savings in the form of avoided costs of developing new fresh water sources and lower fertilizer costs because of nutrients present in recycled water; and on the costs side, capital costs and operations and maintenance (O&M). These are known as market benefits and costs since there is an observable market price to quantify the costs and savings. Though more difficult to quantify, one must also consider in an economic analysis the non-market benefits and costs, like environmental impacts. Non-market benefits and costs are named such because markets do not exist where one can buy and sell them for a price. However, these impacts often represent key local, regional, or societal benefits and costs that if ignored would omit a major portion of any systems-based economic feasibility analysis. To that end, analyzing non-market benefits and costs help cast a wider net in identifying stakeholders and developing collaborative partnerships early in the project planning process.

During the 1970s the concept of cost-effectiveness was introduced to incorporate a more rational basis of comparing alternatives based on true costs while still recognizing nonmonetary factors. Adapted to water recycling, the application of cost-effectiveness can be stated as:

> A water recycling project is considered cost-effective when, compared with the development of other alternatives to achieve the project objective, the proposed project will result in the minimum total resources costs over time to meet project objectives. Resource costs to be evaluated include monetary costs as well as nonmonetary factors, including social and environmental effects. An economic analysis, which monetizes costs and benefits associated with each alternative, including costs or benefits that are not just direct project costs and benefits, is given primary consideration unless other factors are overriding. Other important factors include an assessment of the recycled water market, availability of recycled water, financial feasibility, energy consumption, engineering, and environmental impacts.

Federal and California State funding programs adopted cost-effectiveness as a funding criterion and used the economic analysis as the basis for measuring total resources costs.

Another application of economic analyses is the allocation of costs on an equitable basis. Identifying the true benefits and costs of projects to a practical level of detail can help identify the proportion of the total benefits a project beneficiary is expected to enjoy and is a starting point to identifying an equitable share of funding responsibility.

Funding agencies for recycled water projects in California such as the SWRCB, DWR and USBR, each has its own economic analysis process and criteria for project funding. While there might be overlap in the basic economic analysis, specific requirements may cause the analysis to be incompatible across agencies, so that "apples are being compared to oranges." Similarly, many funding agencies require some economic analysis or data reporting in their applications, but these requirements are sometimes not consistent, causing the applicant to do additional work to tailor each application. A consistent economic feasibility framework across funding agencies would greatly decrease duplicative work, allow projects to be compared by the same criteria and increase the opportunity for communication and collaboration for planning and identifying equitable funding partnerships.

5.1. UNIFORM ANALYTICAL METHOD FOR ECONOMIC ANALYSES

Issue

Each funding agency has its own economic analysis procedure and criteria for project funding. This lack of consistency complicates the task of project proponents intending to apply for State or federal financial assistance. Conducting an economic feasibility analysis often requires a broader investigation so as to include cost or benefit factors beyond the local project area and the non-market benefits and costs. Most local agencies consider only the cash flow factors that the agencies will experience. They are not accustomed to the concept and procedures of economic analyses. In addition, they often do not have the resources to determine some of the factors that should be included in economic analyses, such as impacts beyond their boundaries. To assist local agencies, a methodology to carry out economic analysis is needed.

Defining all potential benefits of a project will also help in distributing the funding burden of projects between beneficiaries. Without an equitable distribution of the funding burden, opportunities may be lost to develop recycled water projects, which is a clear impediment to increasing the use of recycled water.

Recommendation 5.1.1.

The State should lead in developing a uniform method for analyzing projects using economic analysis procedures and a consistent economic feasibility framework across funding agencies. This could be accomplished by an advisory team of economists, recycled water experts, and stakeholders.

a. Identify a set of desirable characteristics for an economic feasibility analysis framework based on true benefits and costs for recycled water projects in California.
b. Review existing frameworks to find the commonalities and gaps based on the characteristics from the above recommendation; add components to the framework that fill in the gaps.
c. Develop a practical and implementable process to identify and include non-market benefits and costs into the framework. Development of non-market benefits and costs that are associated with regions or types of recycled water use would provide results that could be applied to many projects. This is a large task and could be undertaken by both an advisory team and special studies.
d. Develop a mechanism to increase the opportunity for identifying equitable capital and operational funding schemes according to the beneficiaries based on allocation

Water Factory 21, operated by Orange County Water District, provides up to 15 mgd of tertiary and advanced treatment of recycled water injected into an aquifer for groundwater recharge and a seawater intrusion barrier. This has operated since 1975.

of the benefits and costs in the economic analysis. This could include beneficiaries on both the local, regional, and statewide level.

e. Develop guidance to conduct an economic feasibility analysis.

f. Develop a mechanism for information from the economic feasibility analysis to feed into the financial feasibility analysis and funding decision-making.

g. Develop appropriate benchmarks for comparing the incremental costs of developing recycled water with the cost of developing an equivalent amount through other measures such as additional water or demand reduction.

Approach and Implementation:

An expert panel of economists and water recycling specialists should be formed by DWR/SWRCB/DHS to carry out this recommendation. The panel should be formed by September 2003 and submit its findings to DWR by August 2004.

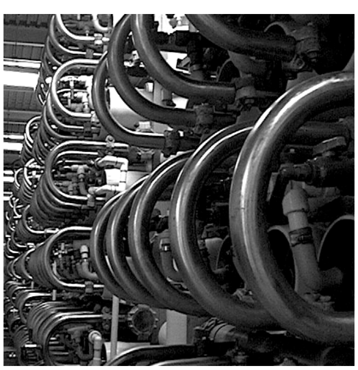
6. Science and Health/Indirect Potable Reuse

Public acceptance of recycled water use is dependent on confidence that its use is safe. The public entrusts regulatory agencies, especially the DHS, to establish sound criteria that will protect public health. To establish such criteria, it is necessary to identify the constituents of health concern that might be present in recycled water, to determine the pathways of human contact, to determine the mechanisms for reducing harmful constituents through treatment, and to calculate the relative health risk.

Four water quality factors are of particular concern: (1) microbiological quality, (2) total mineral content (e.g., total dissolved solids), (3) presence of toxicants of the heavy metal type, and (4) the concentration of stable organic substances. Particularly for the last two categories, recent studies in environmental toxicology and pharmacology have revealed potential long-term health risks associated with chemical compounds such as disinfection byproducts (DBPs) such as N-nitrosodimethyl amine (NDMA), pharmaceutically active compounds (PhACs), pesticides, and personal care products (PCPs) at low concentrations (orders of ppb and ppt). Those trace organic compounds along with some inorganic compounds such as arsenic and hexavalent chromium found in recycled water are of special concern for human and ecological health risk. In addition, there are growing concerns with those trace contaminants in recycled water, which were coincided with increasingly sensitive detection techniques that enabled detection of extremely low contaminant concentrations.

As we expand indirect potable reuse, public concerns increase as well as the uncertainties in our ability to quantify all of the factors. Even with nonpotable uses, some pathogens have become of increasing concern. It is necessary to keep abreast of new chemicals and pathogens of emerging concern to ensure that existing water recycling practices and regulations are continuing to adequately protect public health. In addition, any efforts to introduce new uses of recycled water or changed practices should be based on sound scientific evidence.

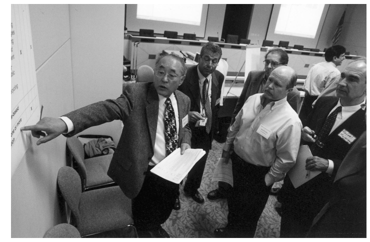
Reverse osmosis is one of the advanced technologies that is used at Water Factory 21 to treat recycled water before direct injection into a groundwater aquifer to replenish the aquifer.



6.1. RESEARCH FUNDING

Issue

Public concerns and perceptions on drinking water safety are a challenge for any water agency. Groundwater recharge with recycled water and indirect potable water reuse in general share many of the public heath concerns encountered in drinking water withdrawn from polluted rivers and reservoirs.



Professor Takashi Asano (l.) leads discussion on science and health issues being addressed by the Recycled Water Task Force.

Continued innovative research in the broad scientific foundations of water recycling and reuse is needed to establish and improve the broad scientific understanding of water reuse in the context of California's sustainable water supply, wastewater generation and disposal, and environmental impact associated with increasing population growth and urbanization. Research needs to address the four water quality factors described in the introduction of this section, technology for treatment and monitoring, mechanisms of human exposure, and assessment of health risk.

Recommendation 6.1.1.

Expand funding sources to include sustained State funding for research on cost-effective treatment, testing and monitoring methods, development of innovative/emerging technologies, study of emerging issues and fundamental scientific principles addressing technology, and public and environmental health related to water reuse.

Approach and Implementation:

The Legislature should pass a bond allocating funds for sustainable State funding for research to DWR or through existing or new mechanisms. In return, DWR should work with academic and research institutions on water resources relevant to water recycling issues. This includes feasibility studies, biophysical, engineering, economical, and social research issues. Time frame: July-December 2003. (See recommendation 1.5.1, Chapter 5.)

6.2. UNIVERSITY ACADEMIC PROGRAM FOR WATER RECYCLING

Issue

It is critical for California to thoroughly assess the best way to manage its water supplies mix and make the best use of recycled water to augment the increasing demand on the limited available freshwater. In addition, water recycling issues cross academic disciplines from water resources to groundwater hydrology to environmental toxicology. There is a need to have an integrated and comprehensive academic program addressing all relevant aspects of water recycling in the context of water resources management. This can be achieved by strong academic and research programs to include a water resources and water recycling curriculum for student development and a collaborative research program with a core of faculty with different expertise and approaches to study water recycling issues. Such academic cores can attract faculty and students to pursue water recycling as an area of interest, producing a steady supply of

Scientific research on recycled water is essential to improve treatment technology, assess the health risk of recycled water, and develop new uses.

*"**Community**" - Public at large including, but not limited to, local ethnic groups, political/social/economic groups, environmental justice advocates and environmentalists.*

*"**Stakeholders**" - Individuals and organizations who are involved in or may be affected by water recycling activities.*

highly trained professionals and a venue within California for fundamental and applied research in this field. Water recycling is too limited a discipline to expect that every university will be able to support a comprehensive curriculum and research program on water recycling. Water recycling tends to be an offshoot of other disciplines. To develop a comprehensive water recycling academic program, it is necessary to interest a variety of faculty to devote some of their research and teaching time to water recycling. Effort should be made to develop such a core program on at least one California campus.

Recommendation 6.2.1.

Encourage an integrated academic program on one or more campuses for water recycling research and education, which is expected to generate well-educated practitioners on water recycling production, quality, and use, using State research funds as an incentive.

Approach and Implementation:

The Legislature should pass a bond allocating funds for a sustainable State funding for research to DWR or through existing or new mechanisms. A portion of research funds should be channeled to integrated academic programs to foster water recycling as an academic specialty for both research and teaching. Time frame: July-December 2003. (See recommendation 1.5.1, Chapter 5.)